

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

ERT3046 – MACHINE VISION  
(RE)

30 MAY 2017  
9:00 am – 11.00 am  
(2 Hours)

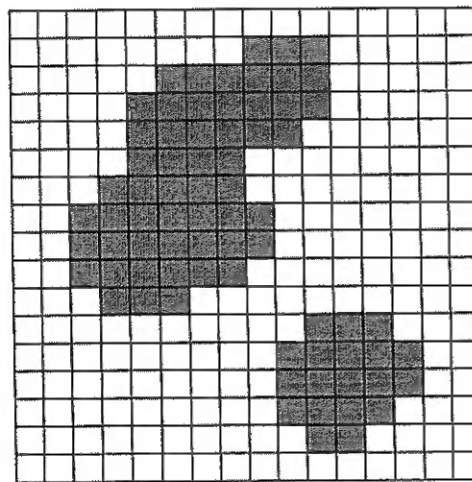
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**INSTRUCTION TO STUDENT**

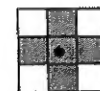
1. This Question Paper consists of 5 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary working **MUST** be shown.

### QUESTION 1

- a) Explain the differences between regular (global) and adaptive thresholding. Give examples of when each type should be used. [3 marks]
- b) **Figure Q1b(i)** illustrates an image containing TWO (2) objects as shaded in gray. Show the output of the following morphological operation if a structuring element (SE) as given in **Figure Q1b(ii)** and **Figure Q1b(iii)** is used respectively.
- (i) Erosion using SE 1 and SE 2 (independently). [2 x 3 marks]
  - (ii) Dilation using SE 1 and SE 2 (independently). [2 x 3 marks]
  - (iii) Opening using SE 1. [3 marks]
  - (iv) Closing using SE 2. [3 marks]



(i)



(ii) SE 1



(iii) SE 2

**Figure Q1b**

- c) With reference to the image shown in **Figure Q1c**, what would the figure shown look like after the following process:
- (i) One pass of step 1 of the skeleton heuristic algorithm. [2 marks]
  - (ii) One pass of step 2 of the algorithm (on the result of step 1, not the original image) [2 marks]

(Note: Assume the darker pixels as the foreground pixels)

Continued ...

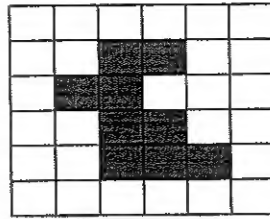


Figure Q1c

## QUESTION 2

- a) State and describe TWO (2) fundamental approaches to partition an image into regions. [4 marks]
- b) Image blurring and sharpening are two contrasting effects of neighbourhood operation (also known as spatial filtering and mask operations) on an image. From your understanding, which of the two processes represent high-pass filtering and describe the visual changes of an image after enhanced using a high-pass filter? [4 marks]
- c) Answer the following questions:
  - (i) From the given quad tree representation shown in **Figure Q2c**, reconstruct the original image by marking the object of interest. [6 marks]
  - (ii) Describe TWO (2) limitations of using the quad tree in representing an image. [2 marks]

(Note: Assume the darker pixels as the foreground pixels (binary 1))

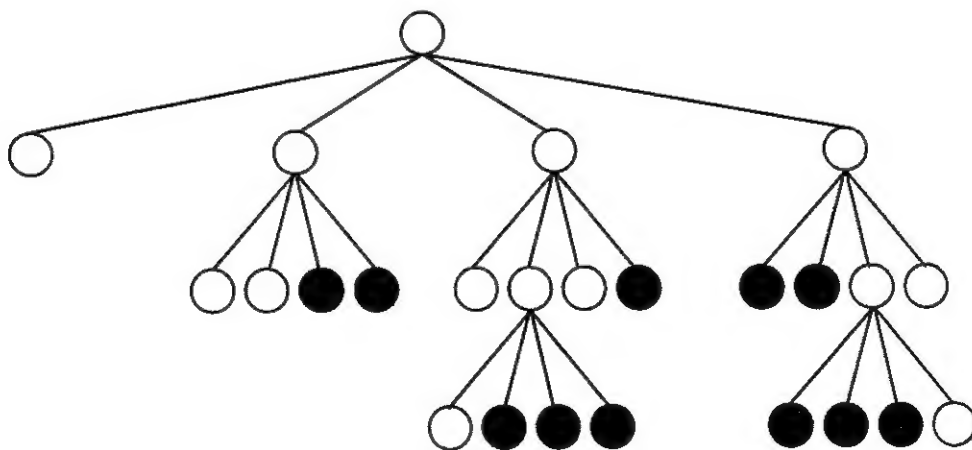
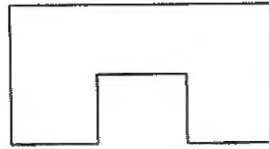


Figure Q2c

Continued ...

- d) Suppose that the order of the shape number for the boundary,  $n$  of an image given in **Figure Q2d** is 12:



**Figure Q2d**

- (i) Illustrate the process involved to generate the shape number. [3 marks]
- (ii) Starting from the top left corner and using 4-direction chain code, obtain the shape number. [6 marks]

### QUESTION 3

- a) List and describe the TWO (2) main approaches to define texture in image analysis. Also, identify the strength of each technique. [6 marks]
- b) Answer the following questions:
  - (i) The gray-level co-occurrence matrix (GLCM) is extensively used and said to provide a better texture analysis and characterization as compared to a simple histogram approach. With the aid of diagram, provide evidence to support this statement. [6 marks]
  - (ii) Obtain a GLCM of a  $5 \times 5$  image composed of a checkerboard of alternating 1s and 0s if the position operator  $Q$  is defined as "two pixel to the right". Assume that the top left pixel has value 0. [4 marks]
- c) **Figure Q3c(i)** shows a padded image. Local Binary Pattern (LBP) technique of  $3 \times 3$  neighborhood region with pixel weights as given in **Figure Q3c(ii)** is applied to the image to analyze the texture pattern. Find the binary code and its corresponding decimal for the following image. (Note that the image is already zero-padded.) [9 marks]

0	0	0	0	0
0	2	3	5	0
0	3	1	8	0
0	8	2	0	0
0	0	0	0	0

(i) Padded Image

6	7	8
5		1
4	3	2

(ii) Weights

**Figure Q3c**

Continued ...

## QUESTION 4

- a) Taking the differences between successive frames to reveal motion information is a popular dynamic vision approach. Elaborate the drawbacks of *difference pictures* that the *accumulated difference pictures* technique attempts to improve. [6 marks]
- b) Briefly describe the following terms:
- (i) Classification [2 marks]
  - (ii) Feature vector [2 marks]
  - (iii) Error rate [2 marks]
- c) Table Q4 shows THREE (3) class  $\{A, B, C\}$  which are characterized by their extracted features  $\{f_1, f_2, f_3\}$ . Two unknown feature vectors,  $m = \{0.32, 0.94, 0.75\}$  and  $n = \{0.67, 0.35, 0.56\}$  have been collected to be classified into one of the specified classes.

Table Q4

Class A				Class B				Class C			
	$f_1$	$f_2$	$f_3$		$f_1$	$f_2$	$f_3$		$f_1$	$f_2$	$f_3$
A1	0.89	0.21	0.57	B1	0.02	0.67	0.98	C1	0.56	0.45	0.12
A2	0.87	0.32	0.45	B2	0.12	0.56	0.79	C2	0.34	0.31	0.67
A3	0.99	0.23	0.55	B3	0.15	0.69	0.88	C3	0.23	0.76	0.51

By using a Euclidean distance as distance as the distance metric, solve the following problems (*Note: answer should be rounding off to two nearest decimal point*):

- (i) Determine to which class, a feature vector  $m$  is classified into by using the *nearest mean classifier*. [6 marks]
- (ii) Considering a two-class problem involving only Class B and Class C. Determine to which class, a feature vector  $n$  is classified into by using the *3-nearest mean classifier*. Repeat this with the *5-nearest mean classifier*. What is the significance of increasing the number of nearest mean classifier? [7 marks]

End of Paper